# Phycological studies — I. New Chlorophyceae from Florida and the Bahamas

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(WITH PLATES 11–15)

## **Halimeda scabra** sp. nov.

Usually dark green, fading to a yellowish green on drying, strongly calcified and commonly rough to the touch, erect or ascending and forming clusters 6–9 cm. high or sometimes reclinate among other algae and reaching a length of 25 cm.: branching mostly dichotomous, usually frequent or somewhat congested, rarely sparing: segments plane, enervate, discoid, subreniform, suborbicular, or occasionally deltoid-obovate, 4–14 mm. broad, 0.6–1.5 mm. thick, margin entire: peripheral utricles hexagonal in surface view, 27–50$\mu$ in diameter, varying from subturbinate to subfusiform in lateral view, 70–240$\mu$ long, galeate, $\frac{1}{6}$–$\frac{2}{5}$ of the length consisting of the acuminate, often indurated terminal cusp; lateral walls in contact for only a small fraction of their length, easily separating on decalcification, usually somewhat thickened or gibbous at the angles of contact: filaments of the central strand fusing in twos or threes at the joints: sporangiophores 1.6–2.5 mm. long, rarely simple, mostly once or twice dichotomous, sometimes subracemose, irregularly proliferous, or in part cymose, fringing the margins of the segments or now and then scattered on the flattened faces, each commonly springing from the fusion of two central filaments; the pyriform sporangia 0.16–0.32 mm. broad, for the most part alternately distichous on the ultimate branches. (PLATES 11 and 12.)

Not uncommon on the coast of Florida and the outlying keys from Jupiter Inlet to Key West; also in the Bahama Islands. It grows on a rocky bottom or about the bases of sponges, from low-tide mark down to a depth of at least three meters. The description has been drawn from a study of thirty or more specimens, representing about as many localities, but our fertile spceimen *no. 2905* from Sands Key, Florida (March 30, 1904), which has furnished material for FIGURES 2 and 3 of PLATE 11 and for FIGURES 1, 3, 5, 7–11 of PLATE 12, we consider the nomenclatorial type.

*Halimeda scabra* is similar to *Halimeda Tuna* in form and habit and it occurs under the latter name in various herbaria. It can, however, be easily distinguished by the always strongly galeate-cuspidate peripheral utricles, a character which, we believe, has thus far been observed in no other species of the genus. These spines or cusps are so large that they are visible under a good hand lens in a properly lighted profile view across a segment-margin even in a dried specimen. The plant is also more strongly calcified than *Halimeda Tuna*, and the peripheral utricles are smaller in surface view and separate more readily on being decalcified. However, *Halimeda scabra* bears a stronger resemblance in outward form to the typical Mediterranean *Halimeda Tuna* than it does to a second South Floridan and West Indian *Halimeda* of the *Tuna* alliance, with which it sometimes grows associated. This second *Halimeda* is larger, always smooth, only slightly calcified, of a bright light green color and lubricous when living and more or less papyraceous on drying. Its segments reach an extreme width, so far as observed, of 35 mm.; and in general, the plant may be said to combine characters of *Halimeda Tuna platydisca* (Decne.) Barton and *H. cuneata* Hering, as these two are limited and defined by Mrs. Gepp (Miss Ethel Sarel Barton) in her admirable monograph on "The Genus Halimeda."* The lateral walls of the peripheral utricles are in firm contact for $\frac{1}{5}$–$\frac{2}{3}$ their length, as in *H. cuneata*, but the peripheral utricles measure 45–120 $\mu$ in surface view, while those of *H. cuneata* are described by Mrs. Gepp as 25–40 $\mu$; the filaments of the central strand separate readily at the joints as in *Halimeda Tuna* instead of being coherent as in *H. cuneata*.† This plant has been met with only in a sterile condition. It seems rather violent to identify it either with *Halimeda Tuna* or with *H. cuneata*, and it is possible that further acquaintance with it will show constant and reliable characters for distinguishing it from both. The *Halimeda scabra* and the smooth plant of the *Tuna-cuneata* alliance have been more or less mixed in certain American exsiccatae. Thus, in the *no. 41*

* Siboga-Expeditie. Monographe LX. 1901.

† Mrs. Gepp alludes (*l.c.* p. 16, 17) to a specimen from Rangiroa brought by Professor Agassiz in the *Albatross*, which forms a connecting link between *H. Tuna* and *H. cuneata*, but this has the peripheral utricles of *H. Tuna* and the joint connections of *H. cuneata*.

of the Algae Exsicc. Am. Bor. of Farlow, Anderson and Eaton, issued as *Halimeda Tuna*, out of seven sets examined, three are *Halimeda scabra*, two are the smooth species, and two contain a mixture of the two species. In *no. 167* of the Phycotheca Boreali-Americana of Collins, Holden and Setchell, distributed as *Halimeda Tuna*, out of ten sets examined, eight are *Halimeda scabra*, one is the smooth *Halimeda*, and one is a mixture of the two. The plants from Jupiter Inlet distributed in Curtiss' Algae Floridanae as *Halimeda Tuna*, also include the two distinct species.

The only specimens that we have seen from Atlantic waters approaching the American shores, which seem to agree thoroughly well with the typical *Halimeda Tuna*, are from Bermuda. These we have found also in a fertile condition.

The sporangiophores of *Halimeda scabra* show a good deal of variety in mode of branching, as will appear from the above diagnosis and from the accompanying figures. A comparison with the sporangiophores of *Halimeda Tuna* as figured and described by Derbès & Solier * and by Mrs. Gepp, † and as exhibited in the Bermudian specimens alluded to above, does not seem to bring out any very important or reliable differences. Possibly the sporangia in *H. scabra* are more regularly distichous. The regular *alternation* of the sporangia in *H. scabra* is often interfered with by the suppression of one or more sporangia or by the occurrence of a cluster of two or three where we would normally expect only one, but a real interruption of the *distichous* arrangement is rarely found, while in *H. Tuna* such interruption is perhaps of more frequent occurrence. It should be noted that in *Halimeda scabra* the stalk of the well-matured sporangium shows in most cases a distinct septum or plug, cutting off, more or less completely, the contents of the sporangium from the sporangiophore. This is variable in position, but is commonly near the base of the stalk and is often accompanied by a slight constriction. The plug, which seems to consist of a callose mucilage rather than cellulose, sometimes extends throughout the length of the stalk to the base of the sporangium, in the narrower sense of the word. It is often

*Suppl. Comptes Rendus hebdom. Séances Acad. Sci. 1: 46, 47. *pl. 11. f. 18–22: pl. 12. f.* 1–5. 1856.

†Journ. of Bot. 42: 193–197. *pl. 461.* Jl 1904.

traversed by a central canal, yet in some cases the lumen appears entirely closed. Some apparently mature sporangia show no trace of a septum or plug, but in such instances similar plugs can usually be found in the rhachis of the sporangiophore and it is probable that these may serve as common septa for two or more sporangia. A basal septum or plug has not been attributed to the sporangium of *Halimeda*, so far as we know; in fact, its existence has been expressly denied,* yet from analogy with *Codium*† of the same family, and perhaps we may say from analogy with the known sporangia of the Siphonales in general, its presence is what would be expected. In the fertile specimen from Bermuda, which we believe referable to *Halimeda Tuna*, the material is less well preserved and less mature and the plugs are more difficult to demonstrate, yet we have observed in this also a few undoubted instances of their presence.

We regret that the opportunity for seeing the living zoöspores of *Halimeda scabra* was not followed out. The material preserved with the aid of formaldehyde does not enable one to get a very good conception of the form and size of the zoöspores, but the protoplast of the sporangium often shows a minutely polygono-radial structure at its periphery.

### **Siphonocladus rigidus** sp. nov.

Caespitose, subfastigiate, rigid, the cushions 2–5 cm. high, of a light translucent green when living: primary ramification mostly dichotomous or subdichotomous, the main axes often also with irregular or subsecund, lateral prolifications: filaments 350–1150 $\mu$ broad, consisting usually of a single series of cells,‡ but often, especially under the dichotomies, becoming two or three cells in width owing to longitudinal or oblique divisions: cells variable in length, mostly about as long as broad, those of

* Schmitz. Sitzungsber. d. niederrheinischer Ges. f. Natur- und Heilkunde, 1879: 143. 1880.— Wille; Engler & Prantl, Nat. Pflanzenfam. $1^2$: 140. 1890.

† Harvey-Gibson, R. J., & Auld, H. P. Codium. L. M. B. C. Memoirs, IV. 1900.

‡ We are aware that certain modern biologists object to applying the word "cell" to the segments of a coenocytic plant like *Siphonocladus*, but its use in this sense is historically and etymologically more accurate than its proposed modern restriction to the "energid" of certain physiologists. Moreover, no substitute entirely satisfactory to the systematist has been suggested. Proposed equivalents, like "segment," "compartment," and "coenocyte" are often either ambiguous or unnecessarily awkward.

prolifications sometimes 10–20 times as long; wall of filament conspicuously lamellate, 15–70 $\mu$ thick (including the enclosed, usually thinner wall of the individual cell); upper face of the diaphragms often strongly mammillose or tuberculose with lamellate elevations, these 30–50 $\mu$ broad: filaments sometimes coherent or concrescent at points of casual contact by means of small, usually oval or quadrate, fibular cells: ordinary cells often forming cysts, either as a whole or after endogenous division (PLATES 13 and 14).

*Siphonocladus rigidus* occurs in southern Florida and in the Bahama Islands, growing in water that is from 3 to 10 dm. deep at low tide, often in association with *Goniolithon strictum* Foslie. It is crisp and rigid when living, crunching under the collector's boot in the water somewhat like the *Goniolithon* whose society it affects. As is common in the family to which it belongs, the dried specimens give a poor idea of the living habit of the plant. Our *no. 1597* from Key West, Florida (October 30, 1902), from which the material used for the published photograph and for most of the drawings was taken, we consider the nomenclatorial type. Specimens collected under this number were distributed in the Phycotheca Boreali-Americana as *no. 1031* under the name *Siphonocladus tropicus* (Crouan) J. Ag.

*Siphonocladus rigidus* is probably more nearly related to *Siphonocladus brachyartrus* Svedelius,* from Magellan's Straits, than to any other described species, but *S. rigidus* is larger and coarser, the filaments measuring 350–1150 $\mu$ in thickness, while those of *S. brachyartrus* are given as but 200–300 $\mu$, the cells are mostly even shorter proportionally than in *S. brachyartrus*, and the branching is more often and more truly dichotomous.

*Siphonocladus rigidus* is allied also to *S. tropicus* (Crouan) J. Ag., yet is sufficiently distinct as may be gathered from a comparison of our photograph of a fluid-preserved specimen (PL. *13*, F. *1*) with the photograph (PL. *13*, F. *2*) of the dried specimen in hb. Agardh, which was communicated by M. Mazé as "*Apjohnia tropica* Crouan" and may fairly be considered the type of the species, inasmuch as J. Agardh was the first (Till. Alg. Syst. **5**: 105. 1887) really to publish a description of it. The specimens from Florida, Barbados, and Mauritius, also cited by J. Agardh as belonging to

* Svenska Exped. till Magellansländerna, **3**: 304. *f. 3* and *pl. 18*. 1900.

that species, as well as specimens in herb. British Museum and herb. Mus. Paris., distributed by Mazé or by Mazé and Schramm as *Apjohnia tropica* Crouan, all maintain the peculiar habit of growth which reminded Agardh of *Chordaria flagelliformis* (*l. c.* p. 103). The most frequent mode of branching in *S. rigidus* is, on the whole, the dichotomous, and dichotomy, so far as we have observed, does not occur in *S. tropicus*. Occasionally, in *S. rigidus*, a fragment in which dichotomies are rare or perhaps wanting and lateral proliferations are numerous, like that illustrated in FIGURE 2, may bear a certain resemblance to *S. tropicus*, but this resemblance, we believe, is illusory,—is even less real than that of *Halimeda scabra* and *H. Tuna*. The cell-walls of *S. tropicus* are comparatively thin, measuring only 3–15 $\mu$ in thickness and the axes of the much elongated flagelliform branches are typically two or more cells broad, except at the extreme apices, while in *S. rigidus* the main branches are of a single series of cells for the greater part of their length; in *S. tropicus*, the ultimate lateral branches are rather uniformly and radially developed, in *S. rigidus* they are somewhat secund or very irregular in length and position; the peculiar mammillosities on the transverse walls, often conspicuous in *S. rigidus*, though not always present, we have never observed in *S. tropicus*.

In our earlier studies of *Siphonocladus rigidus* we had believed we saw the formation of zoöspores and pores for their escape through the wall of the cell, but did not succeed in finding such when the time came for drawing up the description. Cysts, however, are of common occurrence, and these may arise either by the separation and rounding off of the individual cells within the common filament sheath or by the endogenous division of these cells and the formation of new walls. The cells of the filament in the ordinary vegetative condition are rather easily separable from each other within the common filament sheath. FIG. 10 shows the result of applying pressure to the cover-slip above a filament-apex which had previously appeared transversely septate.

A curious and noteworthy feature of *Siphonocladus rigidus* is the apparently constant presence of the delicate hyphae of a fungus (?) closely appressed to its surface. These hyphae are variable in abundance, but we have never seen a branch or even a

cell that was entirely destitute of them. The hyphae run, on the whole, parallel to the direction of growth of the host, either singly or laterally connate in bands of 2–4, occasionally with irregular pseudo-parenchymatous anastomoses, as shown in FIGURE 11. The hyphae are 2.5–6 $\mu$ broad, and septate, the cells being mostly 4–15 times as long as broad and each containing one or more colorless granules. No reproductive bodies have been observed. The fungus naturally suggests the epiphyte in *Blodgettia confervoides* Harv., to which epiphyte Professor E. Perceval Wright * has restricted the generic name *Blodgettia* under the binomial *Blodgettia Bornetii*, yet the two fungi are evidently different things, that on the *Siphonocladus* not only lacking the "conidia" of the other, but differing also in characters of the mycelium. Being uncertain to what extent fungus and alga may be symbiotically related, we have purposely omitted reference to the fungus in our specific diagnosis, preferring to ground the species on the alga alone. It is within the bounds of possibility that future investigations will serve to emphasize the apparent analogies of *Blodgettia confervoides* and *Siphonocladus rigidus* with the Lichenes and that some day there may be recognized a group of marine lichens in which the alga is the dominating symbiont.

**Petrosiphon** gen. nov.

A genus of Chlorophyceae of the family Valoniaceae.† Thallus crustaceous, lightly coated with lime, firmly adnate to the substratum by ventral rhizoids and conforming to the inequalities of its surface, composed of coherent irregularly septate tubes, these dichotomously branched or laterally proliferous as in the genus *Siphonocladus* (without septum at base of branch); the determinate progressive margin consisting of usually a single stratum of radially directed tubes, the older parts commonly showing in vertical section several irregularly superposed tubes, mostly with a radial direction, the central part, however, often consisting of vertical tubes of limited growth and nearly equal length, springing from a horizontal hypothallus. Cysts (aplanospores) frequent; other modes of reproduction unknown.

The genus *Petrosiphon* is allied to *Siphonocladus* Schmitz but

* On Blodgettia confervoides of Harvey, forming a new Genus and Species of Fungi. Trans. Roy. Irish Acad. **28**: 21–26. *pl. 2.* 1881.

† See page 250.

is sufficiently differentiated from that by its flat, compact, crustaceous, more or less calcareous thallus, with determinate outline and radio-marginal growth. The type of the genus and the only species known to the writer is

**Petrosiphon adhaerens** sp. nov.

Forming light-green suborbicular patches, mostly 2–6 cm. in diameter, on rocks, often irregular in outline on an irregular substratum: margins radially striate or sulcate to the naked eye both when living and when dried, everywhere most closely appressed and adnate to the substratum; older central parts sometimes attaining a thickness of 3–5 mm.; tubes mostly 300–580 $\mu$ in diameter, those of periphery often nearly straight and sparingly subdichotomous, those of older parts commonly somewhat geniculate; cells ½–20 times longer than broad, cell-walls mostly 6 to 35 $\mu$ thick, conspicuously lamellate and often showing also transverse striae on surface; vertical tubes in central portion, when well developed, springing from a comparatively thin hypothallus, this commonly consisting of a single layer of horizontal tubes transformed by the vertical elongation of nearly all their component cells: calcification strongest in the vertical contact planes, the walls in these planes remaining rigid on drying while remainder of exposed wall of surface cells collapses, the surface of thallus becoming thereby radio-sulcate toward margin and usually spongiose-alveolate toward center: special fibular cells very rare, adjacent cells, however, often connected by horn-like or subconical processes: ventral rhizoids very numerous, rock-boring, tortuous, branched, septate, mostly 9–27 $\mu$ in diameter: cysts (aplanospores) extremely variable in size and form. (PLATE 15).

Common in the Bahama Islands, growing on surf-beaten calcareous rock near low-water mark and in tide-pools. Our *no. 3322*, collected January 23, 1905, in tide-pools on Silver Cay, near Nassau, from which our published photograph was taken, we consider the type of the species.

The thicker central portions of the thallus of this plant (exclusive of rhizoids) can be readily removed from the rock with a knife, but no specimen adequately representing the thinner marginal parts can be obtained without including also the rock substratum. The delicate rhizoids described above often give a green color to the rock for a depth of 1–2 mm. They are not ordinarily seen at all unless the subjacent rock is carefully decalcified together with the

plant, when they appear as a dense tomentum adhering to the lower surface of all parts of the thallus except a very narrow zone at the growing margin. They are commonly more or less intertangled with filamentous, rock-boring Cyanophyceae. The larger rhizoids are occasionally formed by a ventral evagination of a part of the thallus-tube, the lumina of the two remaining continuous, but the ordinary slender rhizoids, the measurements of which are given above, appear from an early stage to be external appendages to the thallus-tubes, their basal cells standing in about the same relation to the walls of the main cells as do the small fibular cells of *Siphonocladus rigidus* shown in PLATE 14, FIG. 4.

Like *Siphonocladus rigidus*, *Petrosiphon adhaerens* is accompanied by a fungus, or, at least, a chlorophylless filamentous thallophyte, though this is not so uniformly present as in that species; we have never dissected a thallus in which it could not be found, yet large parts are sometimes destitute of it and we are of the opinion that its relation to the alga is that of a parasite rather than that of a subordinated symbiont. The external hyphae lie somewhat loosely among the thallus-tubes or rhizoids; they are fuscous, septate, 2.5–5 $\mu$ broad (cells mostly 2–15 times as long), for the most part sparingly branched, straight or sometimes contorted or torulose; the hyphae finally penetrate the walls of the thallus-tubes and follow their cavities in the direction of their growth, meanwhile becoming lighter-colored and forming much-elongated, ribbon-shaped or virgate-fasciculate, decompound clusters of branches; the cells of these endophytic branches are mostly 5–12 $\mu$ long, ellipsoid, oblong, or ovoid, and are occupied chiefly by a large vacuole, with 1–3 small refringent bodies usually lying close to the wall. Nothing which could be identified with reasonable certainty as a reproductive body of this fungus has been observed.

The only described species, so far as we can discover, which may suggest itself as possibly congeneric with *Petrosiphon adhaerens* is the minute *Siphonocladus voluticola* Hariot, which grows on the shells of *Voluta* in Tierra del Fuego. But this, according to the original description and figures,* and according to supplementary descriptions and figures by Bornet,† is quite different and

*Jour. de Bot. 1: 56. 1887; Mission scientifique du Cap Horn **5**: 22. *pl. 1. f. 2–4.* 1889.

†Bull. Soc. Bot. France **36**: clix, clx. *pl. 10. f. 1, 2.* 1889.

probably generically different. It does not form a solid, coherent thallus and nothing is said of a calcareous coating. Bornet (*l. c.*, p. clix) refers this *Siphonocladus voluticola* provisionally to the genus *Gomontia*, but states that this reference is doubtful owing to the imperfect condition of the specimen.

*Petrosiphon* may, without serious doubt, be placed in the family Valoniaceae as that family is defined by J. Agardh * and by Wille † and perhaps also in the Valoniaceae as more recently limited by Oltmanns, ‡ even though the genus *Siphonocladus*, with which we have compared *Petrosiphon*, is by Oltmanns excluded from the Valoniaceae and made the type of a separate family, the Siphonocladiaceae. But it may fairly be questioned, we think, whether the proposed separation of the Siphonocladiaceae and Valoniaceae as distinct families is not rather difficult and unnatural. The main point of distinction, as pointed out by Oltmanns, appears to be the existence of a "Hauptstamm" in the Siphonocladiaceae, which is lacking in the Valoniaceae. The historical type of the genus *Siphonocladus*, as described and figured by Schmitz, does indeed show a "Hauptstamm," but in most of the species which have since been referred to the genus by Hariot, § Bornet, || Reinbold, ¶ and Svedelius,** the "Hauptstamm" is not readily distinguishable unless, perhaps, in the little-known early stages of growth. In the species described above under the name *Siphonocladus rigidus*, a main axis is soon lost when dichotomies occur as shown in FIGURE 1, but is evident when the branching is as shown in FIGURE 2; nevertheless, both these types of branching are sometimes found in a single tuft and represent, we believe, the variations of a single species.

The specimens from which the above descriptions of new algae have been drawn, including the actual materials which have served as a basis for the published photographs and drawings, are deposited in the herbarium and museum of the New York Botan-

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* Till Alg. Syst. 5 : 11, 90. 1887.

† Eng. & Prantl, Nat. Pflanzenfam. 1²: 145. 1891.

‡ Morph. und Biol. der Algen, 1 : 255, 269. 1904.

§ Jour. de Bot. 1 : 56. 1887.

|| Jour. de Bot. 1 : 56. 1887; De-Toni, Syll. Alg. 1 : 358, 359. 1889.

¶ Hedwigia 37 : (88) Beibl. 1898.

** Svenska Exped. till Magellansländerna 3 : 304. *f. 3* and *pl. 18*. 1900.

ical Garden. The dissections and microscopic preparations, have, however, been transferred from the glass slides, on which they were studied and figured, to glycerine-jelly mounts on slips of mica.

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## Explanation of plates 11-15

PLATE 11. *Halimeda scabra*

1. Photograph of plant, seven-ninths natural size. Specimen collected near Jupiter Inlet, Florida, by A. H. Curtiss, September, 1895.

2. Photograph of portion of fertile plant, one and one-half times natural size. Type specimen, *no. 2905* (Sands Key, Florida).

3. Upper part of the same, three times natural size.

PLATE 12. *Halimeda scabra*

1. Portion of margin of segment, decalcified, in surface view, × 65.

2–6. Peripheral utricles, teased out and decalcified, in lateral view, × 150.

7. Filaments of central strand, showing mode of fusion, × 38.

8–11. Sporangiophores and sporangia; 8 and 11, × 38; 9 and 10, × 24. In Fig. 11, the prevailing distichous arrangement of the sporangia is illustrated and in the older sporangia the position of the basal septum or plug is indicated.

Figs. 1, 3, 5, and 7–11 are drawn from the type specimen, *no. 2905* (Sands Key, Florida) and figs. 2, 4, and 6 from *no.* 2978 (Caesars Creek, Florida).

PLATE 13

1. Photograph of *Siphonocladus rigidus*, natural size. From *no. 1597*, collected at Key West, Florida, October 30, 1902, and now preserved in fluid in the museum of the New York Botanical Garden.

2. *Siphonocladus tropicus* (Crouan) J. Ag. Photograph of specimen in hb. Agardh, communicated by Mazé as *Apjohnia tropica* Crouan, — ⅞ natural size.

PLATE 14. *Siphonocladus rigidus*

1. Portion of plant, showing the more usual ramification, × 5. Near *a*, contiguous branches connected by small fibular cells had been pulled apart.

2. Portion of plant with numerous lateral branches or proliferations, × 5.

3. Surface view of a somewhat similar fragment, × 5.

4. Portion showing the small fibular cells and concrescence of branches at points of contact, × 16, optical section.

5, 6. Fibular cells, × 66.

7. Diaphragm showing mammilliform or tuberculiform elevations, in optical section, × 40.

8. About one-fifth the area of a diaphragm, showing mammilliform or tuberculiform elevations in surface view, × 66.

9. Cysts resulting from the division of the protoplast of a single cell, × 16.

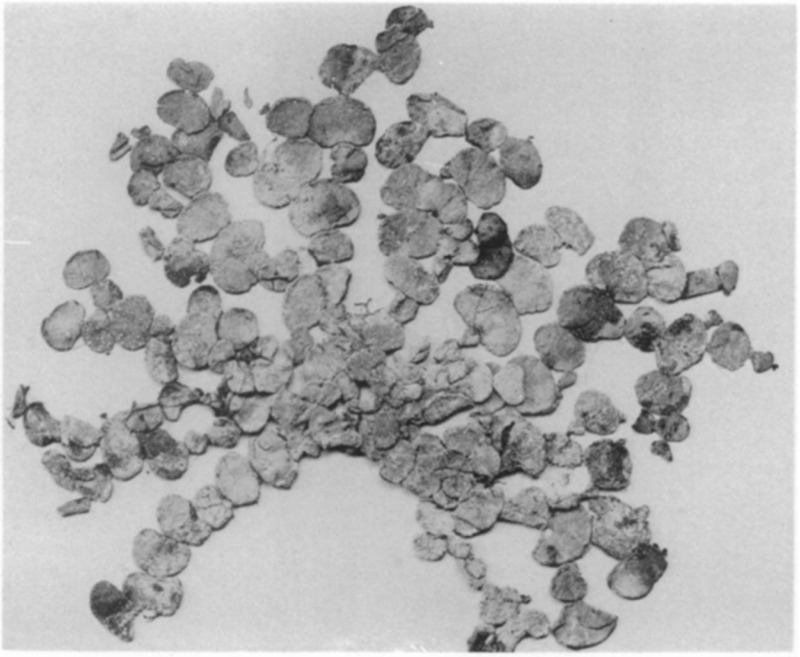
10. One of the filament-apices shown in Fig. 1 as it appeared after crushing under the cover-slip, × 16.

11. Hyphæ of a fungus (?), which is apparently always found on the surface of the cells of *Siphonocladus rigidus*, × 390.

Figures 1, 4–7, and 9–11, have been drawn from our *no. 1597* (Key West, Florida); figs. 2 and 3 from *no. 2771* (Cutler, Dade County, Florida) (similar branching, however, can be found in *no. 1597*); and fig. 8 from *no. 3046* (Hog Island, Nassau Harbor, New Providence, Bahamas).

PLATE 15. *Petrosiphon adhaerens*

A photograph of formalin-preserved specimens collected in tide-pools on Silver Cay, near Nassau, Bahamas, January 23, 1905 (*no. 3322*). The plants were photographed under an enlargement of 1¾ diameters in order to bring out better the radiating component tubes and this magnification is retained in the reproduction. The darker mass just below the middle of the upper right-hand plant is made up of various epiphytes.



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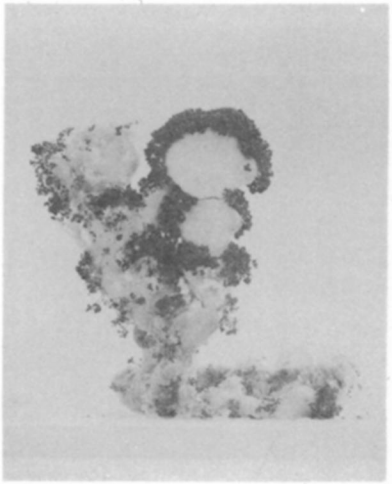

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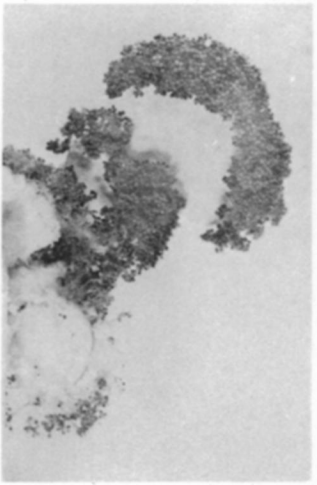
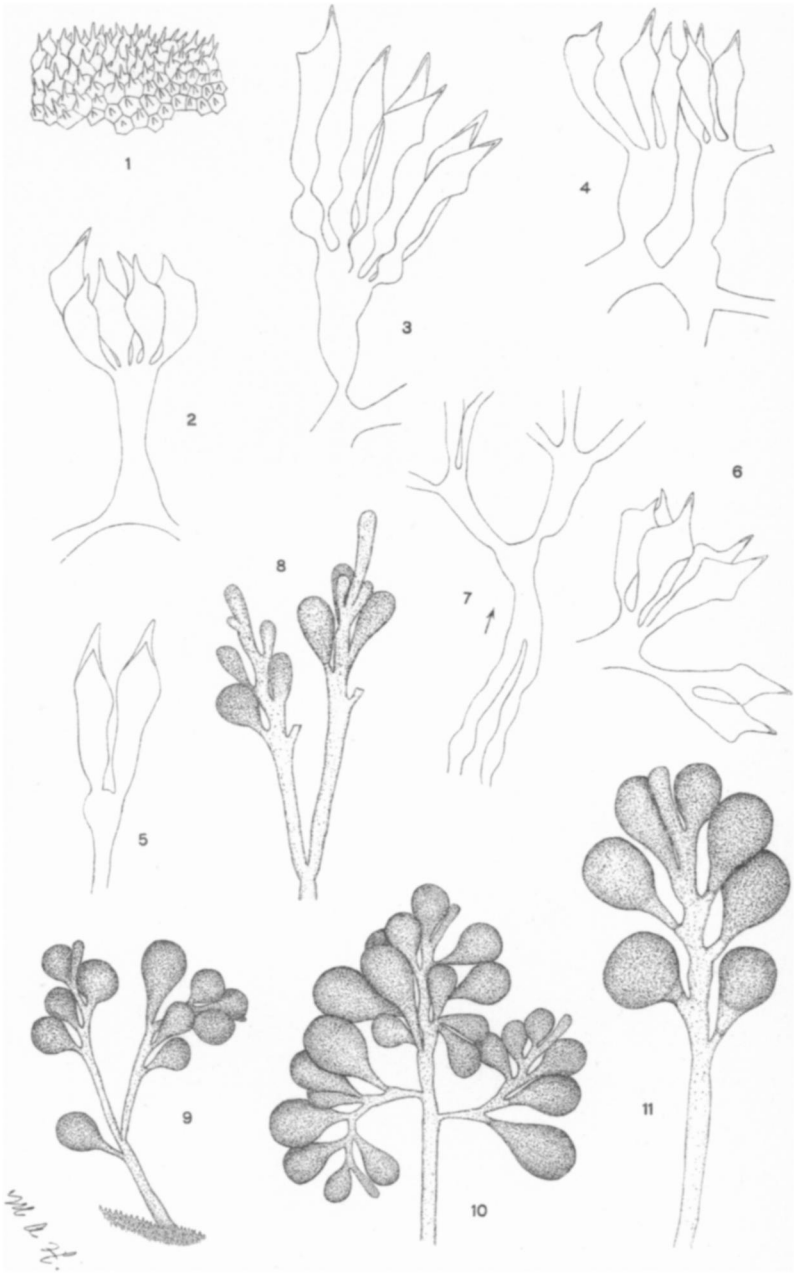


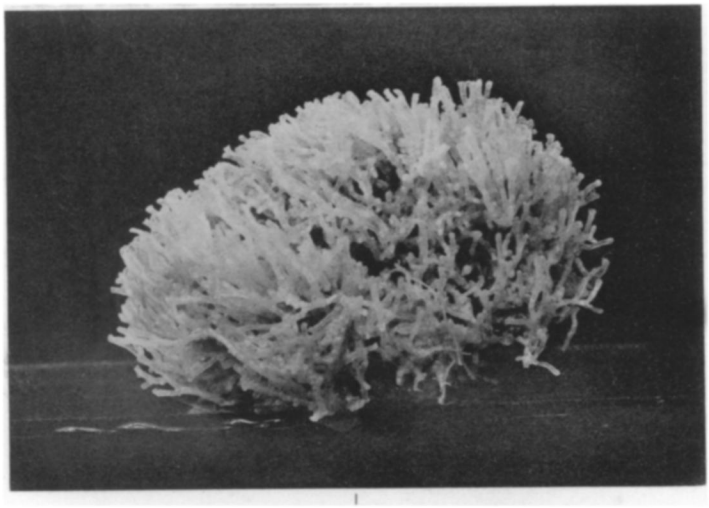
3

HALIMEDA SCABRA M. A. Howe

HELIOTYPE CO., BOSTON.




HALIMEDA SCABRA M. A. Howe.



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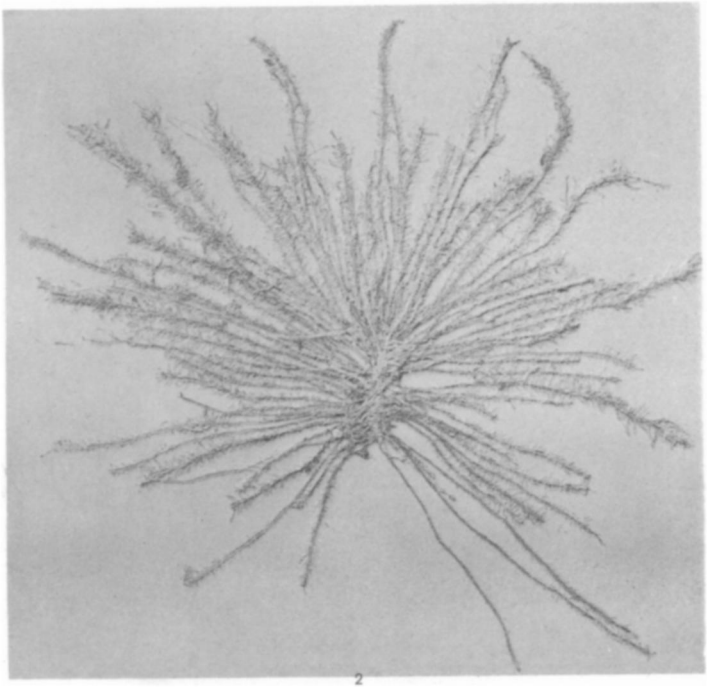
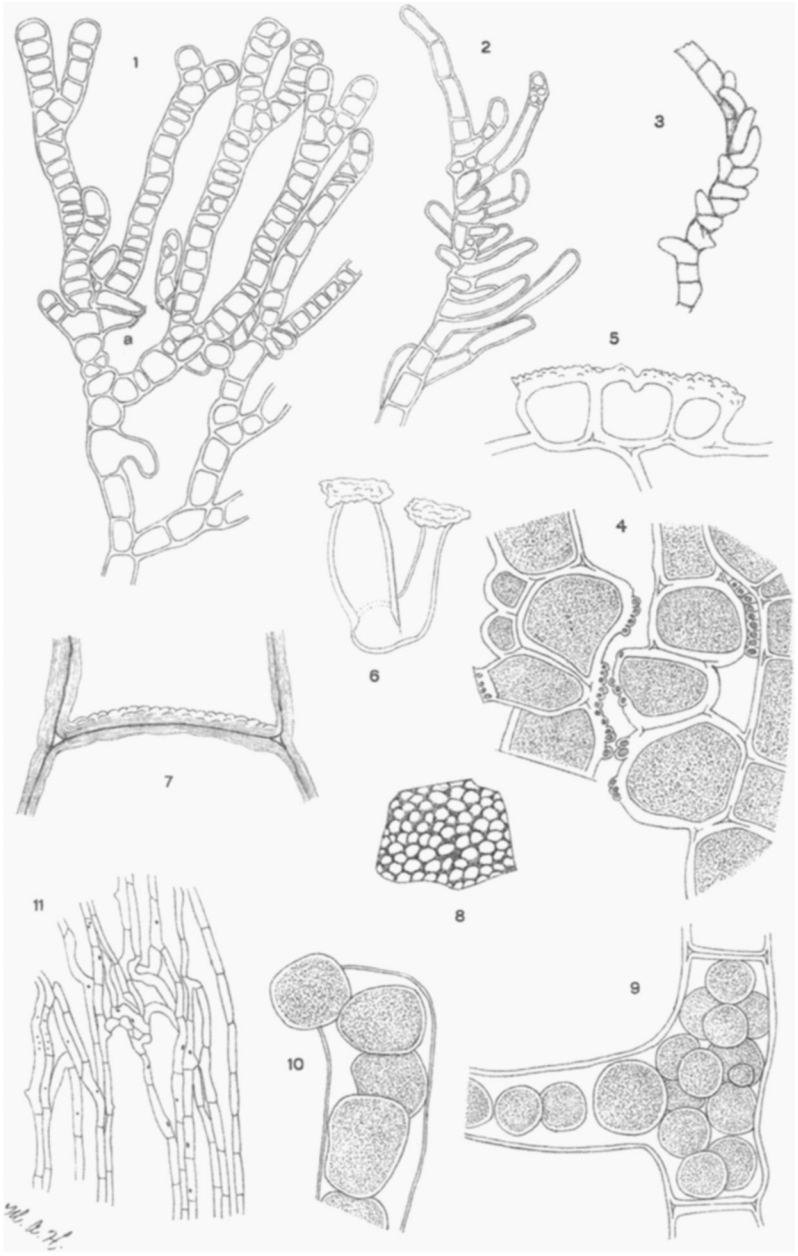


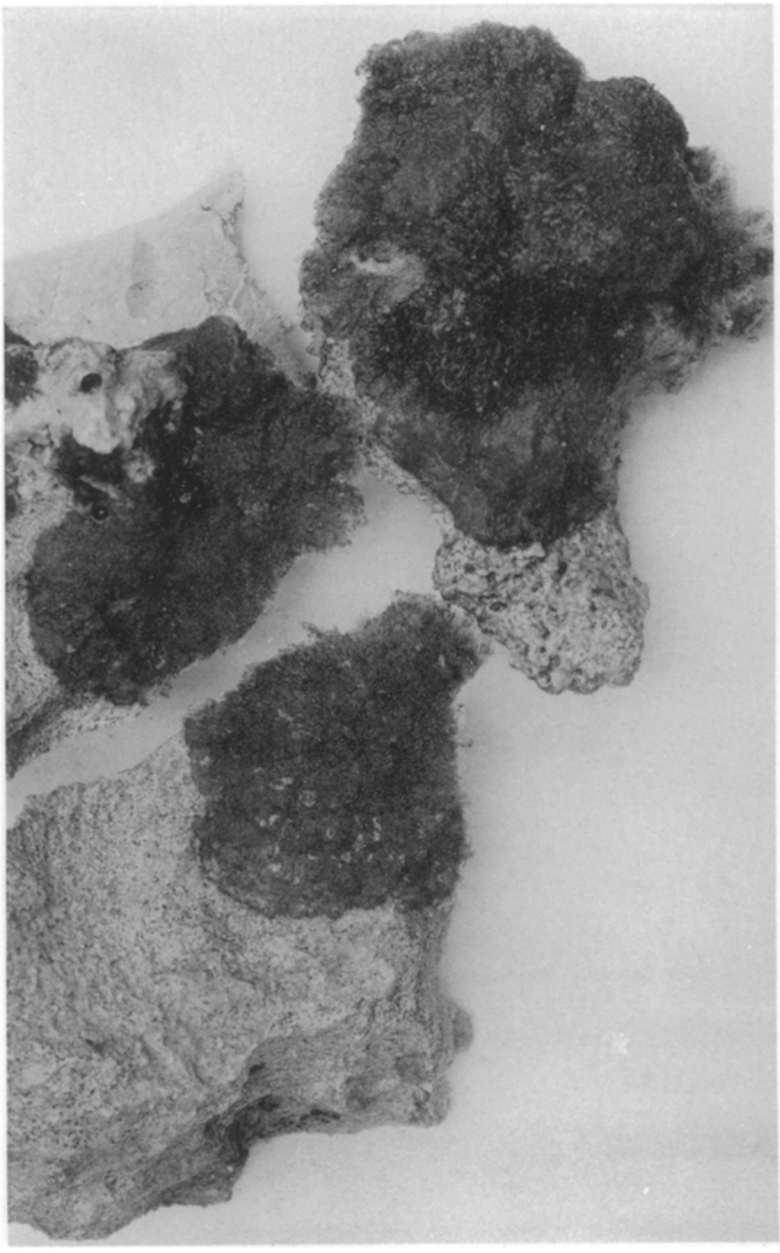
2

1. SIPHONOCLADUS RIGIDUS M. A. Howe
2. SIPHONOCLADUS TROPICUS (Crouan) J. Ag.

HELIOTYPE CO., BOSTON.




SIPHONOCLADUS RIGIDUS M. A. Howe.



PETROSIPHON ADHAERENS M. A. Howe

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